

# Comparative Study of Optical and RF Communication Systems for a Mars Mission

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## ABSTRACT

We have performed a study on telecommunication systems for a hypothetical mission to Mars. The objective of the study was to evaluate and compare the benefits that microwave (X-band and Ka-band) and Optical communications technologies afford to future missions. The telecommunication systems were required to return data after launch and in-orbit at 2.7 AU with daily data volumes of 0.1, 1, or 10 Gbits. Space-borne terminals capable of delivering each of the three data rates were proposed and characterized in terms of mass, power consumption, size, and cost. The estimated parameters for X-band, Ka-band, and Optical frequencies are compared and presented here. For data volumes of 0.1 and 1 Giga-bit per day, the X-band downlink system has a mass 1.5 times that of Ka-band, and 2.5 times that of Optical system. Ka-band offered about 20% power saving at 10 Gbit/day over X-band. For all data volumes, the optical communication terminals were lower in mass than the RF terminals. For data volumes of 1 and 10 Gb/day, the space-borne optical terminal also had a lower required DC power. In all three cases, optical communications had a slightly higher development cost for the space terminal.